

# United States Patent

Wright et al.

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## [54] PARACHUTE DEPLOYMENT SYSTEMS

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[51] Int. Cl. ....A44b 21/00, B64d 17/54

[58] Field of Search .....24/230, 73.05, 230.1, 230.1 P, 24/230.1 V, 230.1 S; 244/149

### [56] References Cited

#### UNITED STATES PATENTS

2,384,651 9/1945 Smith.....244/149

2,924,409 2/1960 Burke.....244/149  
3,142,958 8/1964 Roberts et al.....244/149 X

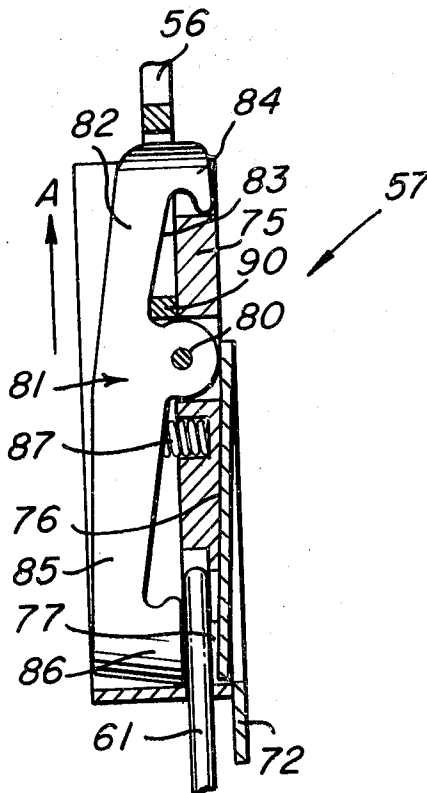
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### [57]

#### ABSTRACT

A parachute deployment system and a connector for use in this system. The deployment system utilizes a pyrotechnic device to launch a weighted projectile which is connected to the ripcord and pilot chute of a parachute pack. The connector is to be interposed between the projectile and the ripcord and comprises a mounting plate and a support releasably retained thereon. The support carries a movable member which, when pressure is exerted on a part thereof, releases the support from the mounting plate and completes a connection between the projectile and the ripcord and pilot chute.

5 Claims, 9 Drawing Figures



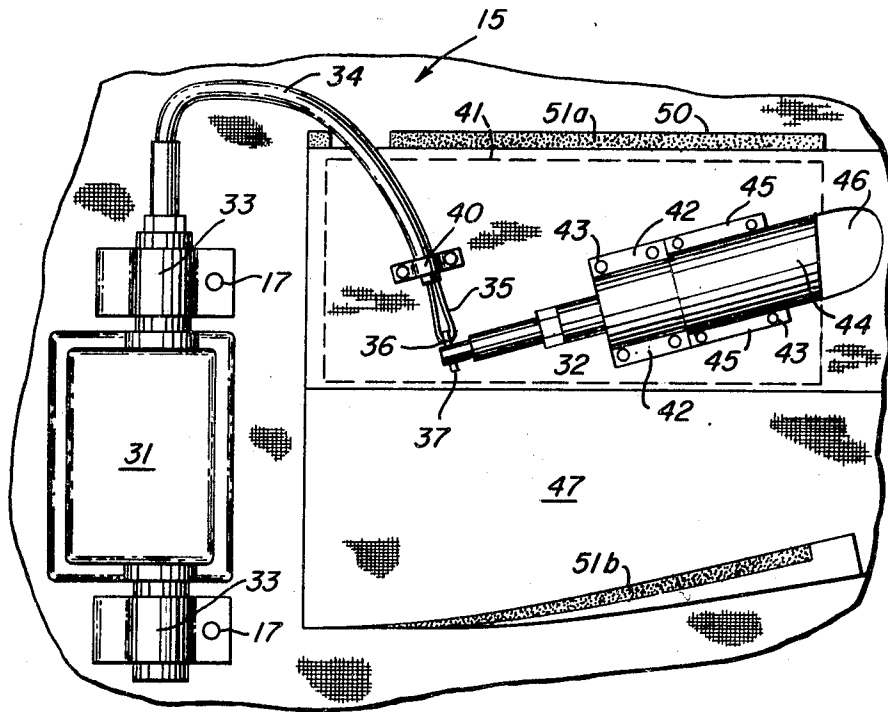


FIG. 1

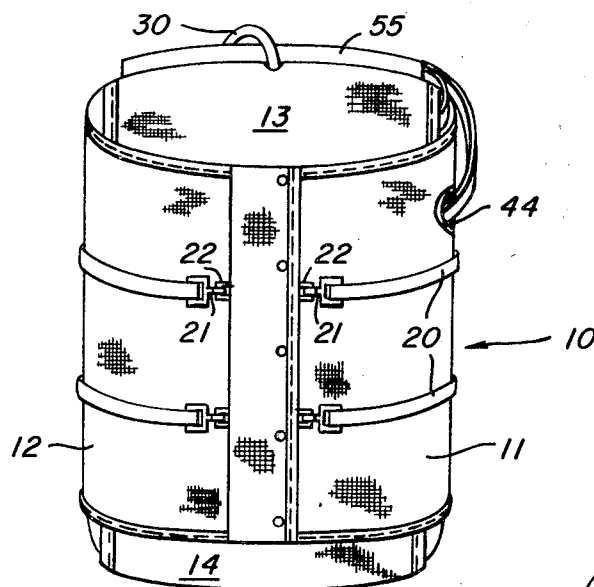


FIG. 2

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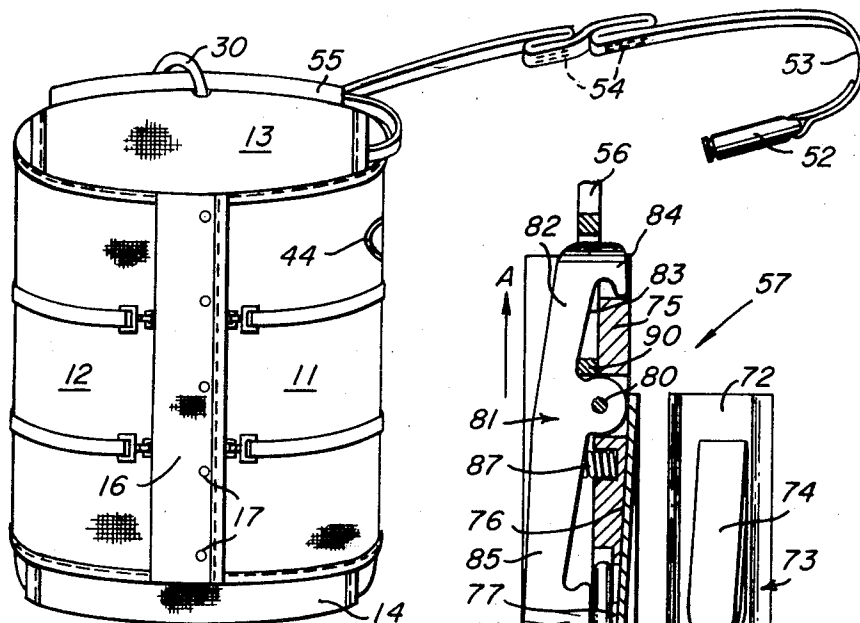


FIG. 3

FIG. 7

FIG. 7A

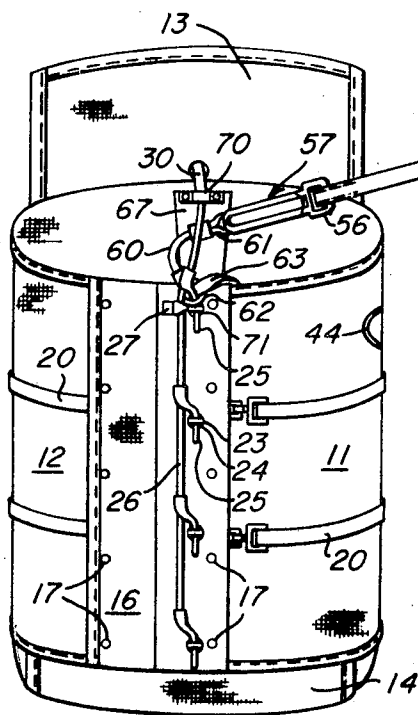


FIG. 4

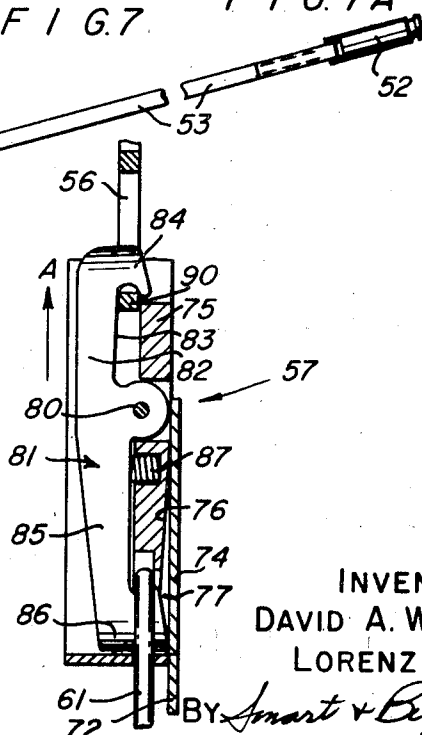


FIG. 8

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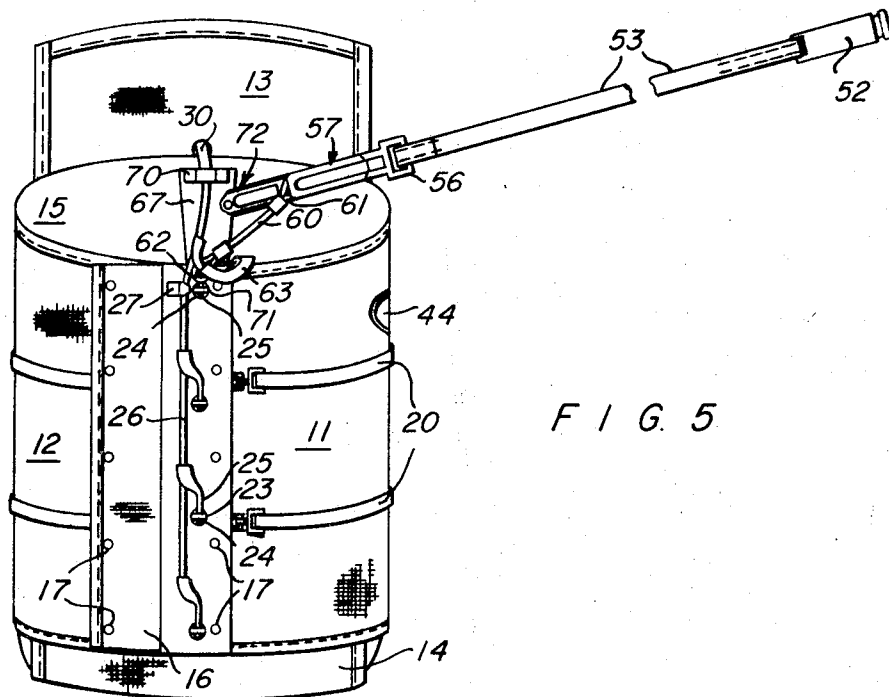


FIG. 5

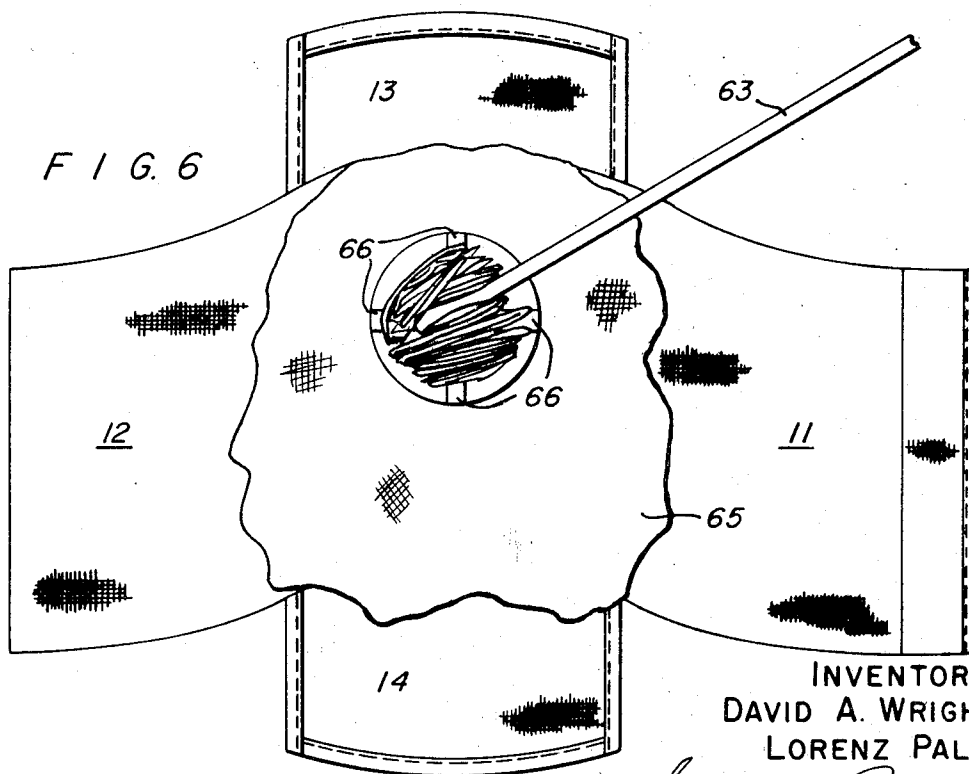


FIG. 6

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## PARACHUTE DEPLOYMENT SYSTEMS

## BACKGROUND OF THE INVENTION

This invention relates to parachute deployment systems and more particularly to systems in which deployment is initiated through the firing of a pyrotechnic device. Throughout this specification the expression "pyrotechnic device" will be used to describe a device in which an explosion in a confined space is used to launch a projectile at relatively high speed such as, for example, a mortar gun.

As a good deal of flying is done at relatively low altitudes and at varying rates of speed, considerable development work has been conducted with a view to reducing the period required for the deployment of a parachute to ensure that it opens in sufficient time to brake the speed of descent of a parachutist regardless of the altitude or velocity of the airplane at the time of his ejection therefrom. If the parachute fails to open in sufficient time to satisfactorily brake the speed of the parachutist before striking the ground the parachutist may be seriously injured or killed as a result, and it is for this reason that speedy deployment of the parachute may be critical when ejection takes place at low altitudes.

Conventional parachute packs include a folded main canopy and a folded pilot chute on top thereof, both the main canopy and the pilot chute being housed within the pack which is closed by means of overlapping flaps. The flaps are locked by means of conical closure members secured to the innermost flap, the closure members projecting through aligned apertures in the outermost flap, with ripcord pins being inserted through transverse bores in the tip portion of the conical members. The flaps are placed under tension by means of elasticized bands which extend around the body of the pack so that the closure flaps fly open immediately when the rip cord pins are withdrawn from the transverse bores of the conical members. In such conventional parachute packs the ripcord may either be pulled manually or automatically by means of an automatic parachute release device. In either case a relatively powerful coil spring is placed beneath the pilot chute to project it out of the pack immediately when the flaps are opened. This is designed to quickly expose the pilot chute to the airstream about the descending parachutist and ultimately results in relatively efficient deployment of the main canopy. However, the entire force required to withdraw the main canopy from the pack, and ultimately separate it from the quarter deployment bag, is supplied by the drag of the pilot chute when it opens. This drag is the reaction of the air to the combined inertia and gravitational forces exerted on the parachutist. Additionally, the pilot chute sometimes becomes entrained in the turbulent airstream created by the descending parachutist with the result that opening of the pilot chute is delayed. It will be appreciated that, at low altitudes, such delays may critically effect the parachutist's chances for survival.

## SUMMARY

We have found that the period required for deployment of a parachute can be significantly reduced by utilizing a pyrotechnic device mounted on the parachute pack to initiate deployment. Such pyrotechnic device is used to launch a weighted projectile which is adapted to be connected with the ripcord and the pilot chute when the pyrotechnic device is fired. The force exerted by the weighted projectile when launched from the pyrotechnic device serves to pull the ripcord pins to open the pack, withdraw the pilot chute from the pack and, in practice, may be sufficiently great to withdraw about two thirds of the main canopy from the pack. This deployment system results in extremely fast deployment of the pilot chute and also ensures that the pilot chute is drawn free of the turbulent airstream created by the descending parachutist. As a significant portion of the main canopy may be simultaneously withdrawn from the pack, the time lag between the pulling of the ripcord and the opening of the main canopy is greatly reduced. Such a deployment system may be

utilized with conventional airplane ejection seats at an altitude range to ground level and in a velocity range from high speeds to zero. By way of comparison, using an ejection seat and a conventional 28 foot flat canopy, and assuming an initial velocity of zero or near zero, a fall of 165-200 ft. or 3.2-3.5 sec. is required to open a conventional parachute, whereas a fall of only 80-100 ft. or 2.2-2.5 sec. is required to open a parachute in accordance with this invention.

In the event that the pyrotechnic device misfires, the parachutist must be able to pull the ripcord manually and it is therefore essential that there be no connection between the pilot chute and the weighted projectile in the pyrotechnic device at this time. Therefore, we dispose, between the pilot chute and the projectile, a connect-disconnect device which normally maintains the ripcord and pilot chute in disconnected relationship with the projectile, but which effects a connection with the projectile in the event of the pyrotechnic device being successfully fired. Such a device comprises a mounting plate, locking means on said mounting plate, a support mountable on said mounting plate, means on said support engaging said locking means to restrain said support against movement relative to said mounting plate in one direction, a first connecting member movably secured to said support, a second connecting member normally freely movable with respect to said support, and means on said support responsive to movement of said first connecting member in said one direction, to secure said second connector to said support and disengage said locking means to permit movement of said support relative to said mounting plate in said one direction.

## BRIEF DESCRIPTION OF THE DRAWING

In the drawings which illustrate embodiments of the invention,

FIG. 1 is a plan view of a portion of a parachute pack showing the pyrotechnic device and firing mechanism therefore,

FIGS. 2, 3, 4, 5 and 6, are front views of a parachute pack showing the sequential opening thereof in accordance with the invention,

FIG. 7 is a longitudinal section of the connect-disconnect device in accordance with the invention

FIG. 7a is a pictorial view of the mounting plate of the device of FIG. 7, and

FIG. 8 is a longitudinal section of the connect-disconnect device of FIG. 7 in operative position.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The parachute pack depicted in FIGS. 1 through 6 is illustrated without the accompanying harness, both because the harness is conventional and because it permits of greater clarity of illustration.

The pack 10 comprises side flaps 11 and 12 and top and bottom flaps 13 and 14 as well as a back portion 15 which is perhaps best illustrated in FIGS. 4 and 5. As illustrated in FIG. 2, when the pack is fully closed, the top and bottom flaps 13 and 14 are tucked inside beneath the overlapping side flaps 11 and 12. As illustrated in FIGS. 4 and 5 side flap 11 has an additional flap 16 extending from the free edge thereof and adapted to be turned back over side flap 11 to cover the ripcord and closures which will be more fully described hereafter. The flap 16 and side flap 11 are provided with mating parts of a conventional snap fastener 17 to hold flap 16 in place when folded back over flap 11 to cover the ripcord and closures. When closed, flaps 11 and 12 are placed under tension by means of elastic bands 20 which pass through appropriate tunnels (not shown) at the back of the pack and which are provided on either end with hooks 21 adapted to engage loops 22 secured to flaps 11 and 12 respectively.

Flaps 11 and 12 are locked in place against the tension of elastic band 20 by means of upstanding locking cones 23 (FIGS. 4 and 5), the bottom of which is secured to bottom flap 14 and passes through aligned apertures 24 in flaps 11 and 12 and the next adjacent two of which are secured to flap 12 and

pass through aligned apertures 24 in flap 11. Each locking cone is provided with a transverse aperture (not specifically illustrated) adjacent the apex thereof and locking pins 25, secured to ripcord 26, are passed through the transverse apertures outside flap 11 to lock the flaps in place. The ripcord 26 passes over a guide 27 secured to flap 11 and through a flexible armored cable 30 through which it passes to a point on the harness where it may be pulled manually by the parachutist, if necessary, to withdraw the ripcord pins 25 to open the pack.

Mounted on the inside back of the pack is the firing mechanism used to initiate deployment of the parachute in accordance with this invention. This mechanism is illustrated in FIG. 1 of the drawings and includes a barometric power unit 31 and a pyrotechnic device in the form of a mortar gun 32. The barometric power unit may be of the type used in automatic parachute release mechanisms and may, for example, be the type MK 10 available from Irving Air Chute of Great Britain Limited. This type is capable of exerting a withdrawal force of 150 pounds and may be factory preset to operate at any desired altitude within the range 3,000 feet to 30,000 feet and at any time delay setting between 0.3 second and 8 seconds. The mortar gun may also be of conventional design and, for example, may be the "drogue gun" available from Atlas Chemical Ind. of Valley Forge, Pa., U.S.A. Such a gun has a muzzle velocity of 250 feet per second and is capable of firing a slug or projectile weighing in the order of 13 ounces. The barometric power unit 31 may be secured to the back 15 of the pack by means of flaps 33 and conventional snap fasteners 17. From the top of the barometric power unit 31 extends a flexible armored sheath 34 through which extends wire cable 35 provided at its end with a loop 36 adapted to engage with the firing pin 37 of the mortar gun 32. The free end of the flexible armored sheath 34 is secured by clamp 40 to a metal plate 41 (illustrated in phantom) embedded in the material of the back 15 of the pack. The mortar gun is provided with flanges 42 which are bolted to metal plate 41 by bolts 43 and the mortar is further provided with a housing 44, which is also flanged at 45 and bolted to the metal plate 41 by bolts 43, and which projects a short distance beyond the mouth of the mortar, through aperture 46 in the material of side flap 11 to shield the pack material from the heat of the mortar and the abrasive action of the projectile which is discharged therefrom.

In order to separate the pyrotechnic device from the interior of the pack, back 15 is provided with a large flap 47 and a small flap 50, the small flap being provided with a strip of fastening material 51a which is that sold under the trademark VELCRO and a large flap 47 being provided with a mating strip of such material along its outer free edge as at 51b. Therefore, when the barometric power unit and mortar gun are ready for operation, flap 47 is folded over the mortar gun and flap 50 is turned over the upper edge thereof, with fastener strips 51a and 51b being pressed together to secure the flap 47 in place.

The mortar gun depicted in FIG. 1 is adapted to fire a slug or projectile such as that designated by the reference numeral 52 in FIG. 3. To the projectile 52 is connected a bridle 53 which is folded back upon itself a number of times (two being illustrated in FIG. 3 as exemplary only) and stitched as at 54. When the pack is folded, bridle 53 is stuffed into an elongated tubular pocket 55 located at the top back of the pack although the other end of the bridle extends therefrom into the pack where it connects with D-ring 56 of a connect-disconnect device illustrated generally at 57 in FIG. 4. The other end of the connect-disconnect device 57 receives loop 61 of connector 60, the other end of which also forms a loop 62 which passes over the top ripcord pin 25. Loop 62 also has secured thereto a pilot chute bridle 63 which extends further into the pack and is connected to the pilot chute 65 through a suitable harness 66.

The connect-disconnect device 57 is secured to a triangular metal plate 67 mounted on a flap at the top of the pack. The upper base of the triangular plate 67 is provided with a clamp

70 to secure the free end of armored cable 30 and the lower apex of the triangular plate 67 is provided with an upstanding loop 71 which projects through aligned apertures 24 in flaps 11 and 12 to serve the same function as locking cones 23 previously described.

The connect-disconnect device is illustrated in detail in FIGS. 7, 7a and 8. The device comprises a base 72 having lateral upstanding intumed edges 73 and a longitudinally disposed upstanding resilient locking tongue 74. A support 75 is provided on each outer side with lateral elongated grooves (not specifically illustrated) adapted to receive the intumed edges 73 which act as guides and permit the support member 75 to slide upon the mounting plate 72. Support member 75 is provided on its bottom surface with a wedge-shaped depression 76 adapted to receive locking tongue 74 and prevent sliding of the support 75 with respect to the plate 72 in the direction indicated by arrow A in FIG. 7. The bottom of the support member 75 is also provided with an aperture 77 aligned with the free end of the locking tongue 74 and the deep end of the depression 76. Mounted on the support 75 on pivot pin 80 is a teeter lever 81 having an arm 82 with a cam surface 83 and a locking projection 84, and another arm 85 with a locking projection 86. A coil spring 87 normally biases the teeter lever 81 so that the end of locking projection 86 is spaced from the upper surface of the base of the member 75 a sufficient distance to permit loop 61 of connector 60 to slide thereunder. The other locking projection 84 is in engagement with an elongated loop 90 of D-ring 56 to which the projectile of bridle 53 is connected.

When force is exerted on the projectile bridle 53 in the direction of arrow A in FIG. 7, the D-ring 56 and loop 90 are pulled in the direction of arrow A and the loop 90 wedges against cam surface 83 of teeter lever 81 to tilt the same about pivot pin 80 against the force of spring 87 to both urge the locking projection 86 into engagement with loop 61 and against spring finger 74 to urge it down out of engagement with the deep end of depression 76. This permits support member 75 to slide out of mounting plate 72 in the direction of Arrow A. It is for this reason that the device is called a connect-disconnect device since the action of teeter lever 81 serves both to connect the support to loop 61 and connector 60 and immediately thereafter, disconnect the support from mounting plate 72.

In operation, the barometric power unit is first set for a specific altitude and time delay, for example, 10,000 ft. and 0.3 second. Cable 35 is connected to the firing pin 37 of mortar 32, flap 47 is closed and sealed and the remainder of the pack is assembled in a more or less conventional manner, except that the top ripcord pin 25 is inserted through loop 62 as well as loop 71 and the loop 61 of connector 60 is inserted into the connect-disconnect device 57. Projectile 52 is inserted into the muzzle of the mortar and the projectile bridle 53 is inserted into pocket 55 whereupon the pack is generally as illustrated in FIG. 2 and is ready to be worn by a parachutist. The pack is designed primarily for use with aircraft ejector seats and, assuming the wearer of the parachute ejects, there is means such as an arming cable connected to the seat harness (not shown) for automatically initiating operation of the barometric power unit 31. If the parachutist ejects at an altitude greater than 10,000 ft. he will free fall to the 10,000 foot level where the barometric power unit will be triggered and cable 35 will be withdrawn to withdraw the firing pin 37 of the mortar 32. Alternately, if the parachutist ejects at an altitude below 10,000 ft. there will be a time delay of 0.3 second before the barometric power unit commences to operate to withdraw the firing pin 37. At any rate, immediately after the firing pin is withdrawn and the mortar fired, the pack assumes the position illustrated in FIG. 3 in which the projectile 52 has just left the muzzle of the mortar and is starting to withdraw bridle 53 from the pocket 55. The track of the projectile lies generally in the plane of the parachutists back and is diverted laterally, generally over one shoulder of the parachutist.

In FIG. 4 (in which flaps 13 and 16 are shown open for illustrative purposes) the bridle 53 is fully extended (stitching 54 has been broken) and the force of the projectile is now applied to the D-ring 56 in the connect-disconnect device 57. This causes the elongated loop 90 to act on cam surface 83 to move the connect-disconnect device 57 into the position illustrated in FIG. 8 wherein loop 61 of connector 60 is securely attached to the device and the support member 75 is permitted to slide over the support plate 72 as illustrated in FIG. 5. As the momentum of projectile 52 continues to act on bridle 53, connect-disconnect device 57 and connector 60, the upper ripcord pin 25 and consequently the ripcord 26 is drawn upwardly over guide 27 to withdraw the ripcord pins 25 and thus unlock flaps 11 and 12 which, under the tension of elastic bands 20, fly open as illustrated in FIG. 6. The pilot chute bridle 63 then proceeds to unfold and eventually tension is applied to the pilot chute harness 66 to withdraw the same from the pack and ultimately the momentum of projectile 52 is sufficient to not only withdraw the complete pilot chute from the pack but also to withdraw about two thirds of the main canopy therefrom. While this sequence is described in its specific stages, in effect, the foregoing happens almost instantaneously with the firing of the mortar. While the pack is provided with conventional spring ejection means for the pilot chute, this means is ineffective when the pyrotechnic device fires as the pilot chute is withdrawn more quickly than would be possible with the spring.

The reversed folding and stitching 54 of the projectile bridle 53 is designed as a type of incremental transfer means to permit the force on D-ring 56 to build up gradually. Otherwise, the sudden impact exerted by the momentum of projectile 52 through extended bridle 53 may sometimes damage the bridle where it connects with the D-ring 56. By means of the reversed folds and stitching 54, a certain part of the momentum of projectile 52 is absorbed as the stitching breaks in successive stages and the impact at the D-ring 56 is not as great as would otherwise result. The extent to which this incremental load transfer means will be used may depend upon a number of factors such as the muzzle velocity of the mortar and the weight of the projectile.

The purpose of the connect-disconnect device is to permit the pack to be opened manually in the conventional manner in the event that, for some reason, the mortar fails to properly fire. Under normal conditions the connect-disconnect device is in the position illustrated in FIG. 7 where loop 61 of connector 60 is free to slide under the end of locking projection 86. Thus, if the mortar gun fails to fire, the ripcord 56 may be pulled manually whereupon the top ripcord pin 25 will simply be withdrawn from loop 71 and loop 62, and the pilot chute will be spring ejected in the conventional manner. However, it is essential that there be no direct connection between the pilot chute and projectile 52 and it is for this reason that the connect-disconnect device has been so designed that, if the mortar gun fails to fire, loop 61 may be easily withdrawn from the end of the connect-disconnect device leaving no connection between the pilot chute and the projectile 52 which is still within the mortar gun.

What we claim as our invention is:

1. A connect-disconnect device comprising a mounting plate, locking means on said mounting plate, a support mountable on said mounting plate, means on said support engaging said locking means to restrain said support against movement relative to said mounting plate in one direction, a first connecting member movably secured to said support, a second connecting member normally freely movable with respect to said support, and means on said support, responsive to movement of said first connecting member in said one direction, to secure said second connector to said support and disengage said locking means to permit movement of said support relative to said mounting plate.

2. A connect-disconnect device comprising a mounting plate, locking means on said mounting plate, a support mountable on said mounting plate, means on said support en-

gaging said locking means to restrain said support member against movement in one direction, and a pivotable member mounted on said support, said pivotable member having a cam surface on a portion thereof and adapted to secure a first connecting member to said support, said pivotable member having a further portion normally disengaged from a second connecting member, movement of said first connecting member in said one direction acting on said cam surface to pivot said pivotable member whereby to cause the other portion of said pivotable member to engage said second connecting member and disengage said locking means to permit movement of said support relative to said mounting plate in said one direction.

3. A connect-disconnect device comprising a mounting plate, locking means on said mounting plate, a support slidably mountable on said mounting plate, means on said support engaging said locking means to restrain said support member against sliding movement in one direction, and a lever pivotally mounted on said support, a cam surface on said lever and means on said lever adjacent said cam surface to secure a first connector thereto, further means on said lever engageable with a second connecting member but normally biased out of engagement therewith, movement of said first connector in said one direction acting on said cam surface to pivot said lever thereby causing said further means to engage said second connector and disengage said locking means to permit movement of said support relative to said mounting plate in said one direction.

4. A connect-disconnect device comprising a mounting plate, resilient locking means on said mounting plate, a support slidably mountable on said mounting plate, means on said support engaging said locking means to restrain said support member against sliding movement in one direction, and a teeter lever pivotally mounted on said support, one arm of said teeter lever having a cam surface thereon and adapted to secure a first looped connector to said support, the other arm thereof being normally biased away from the base of the support to permit passage of a second looped connector therebetween, movement of said first looped connector in said one direction acting on said cam surface to cause the other arm of said teeter lever to engage said second looped connector and disengage said locking means to permit movement of said support relative to said mounting plate in said one direction.

5. A connect-disconnect device comprising an elongated mounting plate having upstanding intumed lateral edges and a longitudinally disposed resilient locking tongue projecting from the upper surface thereof, an elongated support having a longitudinally disposed groove in each side thereof adapted to slidably receive the lateral intumed edges of said mounting plate, there being end openings in said support to receive a looped connector in either end thereof, there being a depression in the bottom surface of said support member to receive said locking tongue whereby to restrain said support against sliding movement relative to said baseplate in one direction, and there being an aperture through the bottom of said support in alignment with the free end of said locking tongue when received in said depression; a longitudinally disposed teeter lever pivotally mounted on said support, with one arm of said teeter lever having a cam surface on the underside thereof and terminating in a downwardly depending projection adapted to secure a first looped connector to said support, the other arm of said teeter lever terminating in a downwardly depending projection in alignment with said aperture and normally biased away therefrom whereby to permit the passage of a second looped connector therebetween, movement of said first looped connector in said one direction acting on said cam surface whereby to move the downwardly depending projection of said other arm through said aperture into locking engagement with said second looped connector and against said locking tongue whereby to urge said locking tongue out of said depression and permit movement of said support relative to said mounting plate in said one direction.

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